CURRENT NEWS
SPECIAL EDITION

22 JULY 1982 No. 883

International Security
CENTER FOR SCIENCE AND INTERNATIONAL AFFAIRS HARVARD UNIVERSITY

SPRING 1982
Pages 78-101

Soviet Military Spending: Assessing the Numbers Game

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Because it is impossible to add tanks and planes, strategic forces and tactical forces, men and missiles without the use of money, total military expenditures have become the most generally-used indicator of overall military effort and effectiveness. So, for example, President Reagan launched his case for increased military spending in his February 1981 State of the Union Message with the statement: "Since 1970 the Soviet Union has invested $300 billion more in its military forces than we have." Further, Americans regularly read in the news media that the Soviet Union outspent us on defense last year by 50 percent.

These figures were estimated by the CIA. The CIA also tells us that the Soviet Union is spending 12–14 percent of its GNP in comparison with America's 5–6 percent and that Soviet military expenditures have been growing faster than those of the United States over the past decade. One need not feel that these types of estimates are very good grounds upon which to base U.S. military planning in order to concede that they have an important impact on U.S. policies.

Because the Soviet Union does not publish reliable information on its defense spending, the CIA's procedure is to estimate, by hook or crook, the quantities of men, tanks, missiles, ammunition, and so forth of everything purchased each year by the Ministry of Defense. These items are then valued in dollar or ruble prices, as the case may be. In these exercises, the CIA encounters many problems, the solutions to which have not always been acceptable to its critics. A major problem—the so-called index number problem—is a case in point, and is the subject of this article.

This paper has benefited considerably from discussions with Abram Bergson and Gilbert DeBartolo, who do not necessarily share its views. I am also indebted to James Steiner and Derk Swain of the Office of Strategic Research (OSR) of the CIA and to Dan Gallik of ACDA for clarifying, within the limits of security, some of the procedures followed by the CIA in calculating Soviet military expenditures. Unfortunately, the security net is very wide and it is not easy for the outsider to get a firm grasp on many of the CIA practices.

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Representatives of the CIA, both orally and in print, have attempted to rebut the argument, presented in *International Security*,[1] that the Agency's published estimates significantly understate the index number effects and thereby overstate Soviet military expenditures relative to those of the United States. No one, to my knowledge, has even considered the impact of index number considerations on the CIA's ratio of Soviet military expenditures to GNP (ME/GNP) or on the rate of growth of Soviet military expenditures themselves.

In what follows, I will explain first, by means of a simple example, the nature of index number effects for those who are unfamiliar with the concept. Then, an attempt will be made to deal with the contentions of the CIA and others who minimize the relevance of index number effects to the Soviet–American military expenditure comparison. Further, I will advance the argument that the factors which overstate Soviet military expenditures relative to those of the United States also may cause an overstatement of the percentage of Soviet military expenditures to GNP. Finally, I will examine the effects of index number considerations on the growth of Soviet military expenditures (ME).

Index Number Effects

Individuals and nations tend to produce and consume more of those commodities and services that are plentiful and cheap and fewer of those that are scarce and more expensive. Comparatively speaking, the United States has less labor and more capital than does the Soviet Union. As a result, 1) labor-intensive commodities and services are relatively more expensive and capital-intensive relatively cheaper in the United States than in the Soviet Union,[2] and 2) Americans tend to produce and consume fewer labor-intensive and more capital-intensive products than do the Soviets. This explains why most observers believe that the American military establishment has fewer personnel and, per person, more equipment than the Soviets'. Similar reasoning can be used to explain why, in the area of military equipment, American equipment tends to be more technologically advanced than the Soviets'. That is, the United States has a comparative advantage in advanced

1. Franklyn D. Holzman, "Are the Russians Really Outspending the U.S. on Defense?" *International Security*, Vol. 4, No. 4 (Spring 1980), pp. 86–104.
2. Evidence for this is presented at the beginning of this essay's second section.

Table 1. The Continental Breakfast Gap

	Oranges	Croissants	Total Cost	French cost/ U.S. cost	U.S. cost/ French cost
United States					
Price	$.25	$ .50			
Quantity	2	1			
Cost of U.S. breakfast in dollars	.50	.50	$1.00		
Cost of French breakfast in dollars	.25	1.00	$1.25	1.25	0.8
France					
Price	2F	1F			
Quantity	1	2			
Cost of French breakfast in francs	2F	2F	4F		
Cost of U.S. breakfast in francs	4F	1F	5F	0.8	1.25
Geometric mean				1.0	1.0

technology, products embodying it are cheaper to produce in the U.S. than in the USSR, and Americans therefore consume more of it than do Soviets.

In order to compare Soviet and U.S. defense expenditures, the CIA values the Soviet military establishment in dollar prices. This tends to overvalue the Soviet military establishment because those things that the Soviets spend a lot on because they're relatively cheap in rubles (e.g., manpower) are very expensive in dollar prices. By contrast, a ruble price comparison would exaggerate American expenditures because the U.S.'s "relatively" greater quantity of military equipment, particularly high technology equipment, is very expensive in rubles.[3]

A simple example may clarify the argument. Assume that we are trying to compare the expenditures on breakfast of a Frenchman and an American. To keep the calculations simple, assume that breakfast consists of only 2 commodities, oranges and croissants. As anyone who has been to France knows, bread products are relatively cheap and citrus fruits relatively expensive compared to the United States. So, the relative prices shown in Table 1 reflect

3. "Given resource endowments and technologies, countries tend to use more of the resources that are relatively cheap—and less of those that are relatively expensive—for a given purpose. A comparison drawn in terms of the prices of one country thus tends to overstate the relative value of the activities of the other." CIA, *Soviet and U.S. Defense Activities, 1970–1979: A Dollar Cost Comparison* (Washington D.C.: U.S. Government Printing Office, 1980), p. 3.

this fact. Since oranges are relatively cheap in the U.S., we have the American consuming 2 oranges and 1 croissant for a total cost of breakfast of $1.00. With croissants relatively cheap in France, we have the Frenchman choosing 1 orange and 2 croissants for a total cost of 4 francs. Now, following the CIA military expenditure methodology, the Americans compare breakfast expenditures with the French by valuing the French breakfast in dollars. Valued in U.S. dollar prices, the French spend $1.25, or 25 percent more than the Americans for a so-called "Continental Breakfast Gap." The French make a similar comparison by valuing the American breakfast in French prices to discover that the Americans are spending 5 francs or 25 percent more than they are. A geometric mean of the dollar and franc ratios of French to American cost (1.25 and .8) is 1—which means that, statistically speaking, the Frenchman and the American are spending the same amount for breakfast, even though each sees the other as spending more.[4] The geometric mean is a common method of averaging results in two different sets of prices and is used by the CIA in most of its economic comparisons.

It is important to note, in the example presented above, the two conditions that are necessary to the index number effect. First, the two nations must be consuming different proportions of the commodities in question. Second, the relative prices of the commodities must also differ between the two nations and the relative quantities of goods chosen by each nation will vary inversely to those prices. That is, each nation consumes relatively more of the product which is relatively cheap, and less of the product which is relatively expensive. If either the ratio of prices *or* the ratio of quantities consumed is identical in the two nations, there is no index number effect.[5]

While the CIA's Office of Strategic Research (OSR) always presents its official estimates of military expenditures in dollar prices, it does calculate an unofficial ruble comparison which, until 1980, it claimed was "casual" and "rough" because of inadequate information, presumably an insufficient number of ruble prices of military equipment. For this reason, one may assume, a geometric mean of Soviet and American defense spending figures has never been presented.

The striking thing about the CIA's ruble ratio of Soviet to American military expenditures is that, while lower than the dollar ratio, it is not much lower

4. As this example suggests, index number effects all by themselves have the capability of contributing to the arms race. Each nation thinks the other is spending more than is true as indicated by less biased measures.
5. This is easily verified by appropriately altering the example in Table 1.

Table 2. Selected USSR/U.S. Expenditure Ratios, 1976

	rubles	dollars	dollar /ruble spread
GNP	.495	.735	1.49
Consumption	.352	.543	1.54
Investment	1.076	1.403	1.30
Machinery & Equipment	.863	1.414	1.63
Defense and Space	1.292	1.440	1.11

Source: Calculated from Imogene Edwards, Margaret Hughes, and James Noren, "U.S. and U.S.S.R.: Comparisons of GNP," in U.S., Congress, Joint Economic Committee, *Soviet Economy in a Time of Change*, Vol. 1 (Washington, D.C.: USGPO, 1979), p. 378. These figures were calculated by the Office of Economic Research of the CIA, and the Defense and Space figure differs slightly from OSR's estimate.

and CIA spokesmen regularly stress this fact.[6] That is, they argue that it doesn't matter whether dollars or rubles are used—the USSR outspends the United States by a large amount by either measure. This is in sharp contrast with the difference between ruble and dollar ratios for most other sectors of the economy as Table 2, showing selected CIA ratios for 1976, indicates.

Two major defenses of the CIA's low dollar–ruble spread in the military sector have been presented[7] and these will be dealt with in turn in the following two sections.

Structure of U.S. and Soviet Military Expenditures

Most economists agree with former CIA Director Admiral Turner that "military hardware is much more expensive than manpower in the Soviet Union while in the United States manpower is relatively more expensive than hardware. . . ."[8] It is also admitted by the CIA's Office of Strategic Research that high technology equipment is relatively cheap in the United States in comparison with ordinary machinery, which is relatively cheap in the Soviet Union.[9] So, the price conditions for strong index number effects exist.

6. CIA dollar and ruble ratios are presented in Table 5 below.
7. Since many ruble prices of civilian goods must be unavailable to the CIA, the civilian index number spreads in Table 2 must also be understated, though by a much lesser amount than in the military sector.
8. U.S., Congress, Joint Economic Committee, Congress of the United States, *Allocation of Resources in the Soviet Union and China* (Washington D.C.: USGPO, 1978), p. 71. Published annually from 1974 to 1980.
9. U.S., Congress, House of Representatives, Permanent Select Committee on Intelligence, *CIA Estimates of Soviet Defense Spending* (Washington D.C.: USGPO, September 1980), pp. 74–75.

CIA representatives argue, however, that there are no large index number effects—no large differences between ruble and dollar comparisons—because the relative quantities of 1) personnel to weapons, and 2) high-technology equipment to low-technology equipment are approximately the same in the military sectors of the two nations.[10] In effect, it is argued that the first of our two conditions necessary for index number effects isn't significant, either at the most macro-level between personnel and weapons or within the weapons category between higher technology and lower technology weapons.

This contention is supported with the interesting argument that, in the military competition between the United States and the Soviet Union, economic forces are of little importance. So, despite the fact that prices of labor and capital differ widely between the two nations, "They are each preparing, among other things, to fight each other should that ever happen, and they are each driven to a similar force mix. . . ."[11] This is a fairly persuasive argument because, undoubtedly, the military sector in both countries is less constrained by "economics" than are other sectors. Nevertheless, it is difficult to believe that economics plays no part in military mix decisions.

One can find many opinions which take issue with the second of these propositions, on the equivalence of weapons. In 1977, Admiral Turner told the Joint Economic Committee that ". . . while virtually all of the Soviet inventory of weapons falls within U.S. production technology, the Soviets simply do not have the technology required to produce many of the U.S. weapons nor could they produce close substitutes. . . ."[12]

Derk Swain of CIA-OSR presents a similar view before the Committee on Armed Services of the Senate:

> **"Mr. Swain:** [Soviet weapons] will tend to be less costly than a given U.S. submarine or airplane because the United States tends to build in more sophistication, more quality, and better performance than the Soviets choose to.
>
> **Senator Warner:** And I might add, more safety.
>
> **Mr. Swain:** Yes; more quality control, more across the board, a more highly designed product, and it costs more. . . ."[13]

10. *Ibid.*, and U.S., Congress, Joint Economic Committee, *Allocation of Resources in the Soviet Union and China* (Washington D.C.: USGPO, 1980), p. 150.
11. Permanent Select Committee, *CIA Estimates*, p. 75.
12. U.S., Congress, Joint Economic Committee, *Allocation of Resources in the Soviet Union and China* (Washington D.C.: USGPO, 1977), p. 40.
13. U.S., Congress, Senate, Committee on Armed Services, U.S. Senate, Hearings on *Soviet Defense Expenditures and Related Programs* (Washington D.C.: USGPO, 1980), p. 118.

These statements suggest,[14] contrary to the earlier CIA argument, that the mixes of technology and quality of weapons in individual categories may be quite varied and, we might infer, are likely to generate substantial index number effects. Further, the dialogue just quoted suggests strongly that economics *is a factor* in military mix choices. If it were not, wouldn't the Soviets be producing as high quality weapons as they are capable of? And certainly the higher cost of American soldiers, and the consequent necessity of utilizing them as efficiently as possible, is partly responsible for the American practice of equipping them with the best possible weapons. The reverse has undoubtedly been true of the Russians. Having a large, relatively low-cost army, and with capital more expensive, they are less moved to produce equipment with an American emphasis on quality, safety, etc.

For these reasons, I feel that index number effects are a substantial factor in comparing U.S. and Soviet procurements of military equipment, despite the CIA's argument to the contrary.

PRICING HIGH TECHNOLOGY

Three additional points on the index number effects within the hardware sector need to be made. First, when CIA representatives speak about the parallels between the weapons of the two nations, they are undoubtedly viewing the weapons at a fairly high level of aggregation. This could well mask large disparities at more disaggregated levels.

Second, as noted elsewhere,[15] there are many U.S. weapons which the Soviets are incapable of producing because they are too advanced technologically. The CIA method of pricing these in rubles is to assume that they *can be produced* by Russians, and to value them at conventional low ruble prices.[16] This, in effect, deflates the effect of American technological supe-

14. William J. Perry, former Undersecretary of Defense for Research and Evaluation, also presents an authoritative opinion of U.S. technological superiority. He claims that the United States is superior to the Soviet Union in 15 of the 20 most important basic technology areas and equal in the remaining 5. Further, the level of U.S. technology in deployed military systems is superior to that of the Soviet Union in 14 cases, equal in 9, and inferior in 7. *The FY 1981 Department of Defense Program for Research, Development, and Acquisition*, Statement to the 96th Congress, February 1, 1980, pp. II-36, 37. Another similar view is provided by Jack Vorona, the CIA's Assistant Director for Scientific and Technological Intelligence. Committee on Armed Services, *Soviet Defense Expenditures*, p. 86.
15. Holzman, "Are the Russians Really Outspending the U.S.?" p. 93.
16. I envision the CIA's procedure to be essentially as follows. Suppose the Soviets are incapable of producing the equivalent of an F-15 fighter which costs, say, $30 million to produce in the United States. Suppose, however, the Soviets can produce the equivalent of an F-5 for 8 million

riority and reduces American expenditures on hardware priced in rubles—hence reduces the index number effect.[17]

The CIA response to this argument is ". . . that there are not all that many things that the United States has that the Soviets couldn't build today if they wanted to. . . ."[18] What this statement ignores is the fact that the CIA's ruble calculation is not in current rubles (as the U.S. calculation in dollars is) but is in "constant 1970 rubles."[19] That is to say, the CIA is not attempting to value American and Soviet equipment in current ruble costs, but rather at what it would have cost to produce the (high-technology) equipment in the Soviet 1970-vintage factories. Obviously, in 1970, the Soviet Union could not have produced at all, the issue of reasonable cost wholly aside, a large percentage of the current U.S. advanced-technology weapons and equipment. In fact, neither could it have produced *cheaply* a good part of the most modern *Soviet* weapons and equipment, although it certainly would have been more capable of producing these than of producing their American counterparts.

Third, because the CIA has an insufficient number of ruble prices and must make its ruble calculation at a high level of aggregation,[20] much of the index number effect fails to show up in its calculation. The effect of "adding together" costs for which no ruble values are available will be discussed at greater length below.

One implication of these three points is that while OSR claims (mistakenly) that the Soviets have "over twice as much equipment"[21] as the United States when the comparison is made in *dollar prices*, the ratio could well be much less if a proper ruble valuation were made. This has, of course, important implications for the index number effect between personnel and military hardware, to which we now turn.

rubles in comparison with the U.S. price of $10 million. The CIA's procedure basically would be to use the F-5 dollar–ruble ratio ($5/4r) and value the F-15 at 24 million rubles.

17. The argument is spelled out in Holzman, "Are the Russians Really Outspending the U.S.?" pp. 93–94.

18. Permanent Select Committee, *CIA Estimates*, p. 76.

19. I owe this information to Derk Swain (personal conversation). So far as I know, the CIA's unclassified publications nowhere indicate whether its ruble counterpart of the dollar estimates is in current prices or in constant prices of some year.

20. That is to say, with only a small number of ruble prices of military goods available, most commodities have to be combined (aggregated) in large groups first in dollars and then, as a group (e.g., vehicles), priced in rubles by converting through the few dollar–ruble ratios which are available. See below.

21. Permanent Select Committee, *CIA Estimates*, p. 75.

DISSIMILAR MIXES: NECESSARY CONDITIONS FOR INDEX NUMBER EFFECTS

In fact, at first glance, the OSR claim appears to be inconsistent with the CIA's overall evaluation of the Soviet–American military expenditure gap. If the Soviets have more than twice as many men and more than twice as much equipment as does the United States, and if according to the CIA's latest annual statement,[22] the Soviets are spending twice as much as the Americans on Research, Development, Test and Evaluation (RDT&E), one would begin to suspect that the Soviet Union must be outspending the United States by more than two-to-one, and that the USSR–U.S. ratio should be above 2.00. But the CIA's official estimate shows the ratios in 1979 and 1980 to have been 1.50 in dollars and 1.30 in rubles (see Table 5). There is an apparent inconsistency here.

In an effort to resolve the inconsistency, I have attempted to construct a more detailed dollar comparison of the two nations' military expenditures in 1980 than the CIA makes available. If the estimates in Table 3 are correct, two facts emerge. First, the Soviets do not have "twice as many men in uniform . . . and over twice as much equipment" as the United States, a claim that, if true, would invalidate index number effects. In fact, they have 2.15 as many men and approximately 1.67 times as much equipment *in dollars* and much *less*, undoubtedly, *in rubles*. That is to say, on the average, procurements of equipment per U.S. soldier were almost 25 percent greater measured in dollars—and still greater measured in rubles—than Soviet procurements per soldier. Conditions *do*, in short, seem to exist for index number effects to be at work in this expenditure comparison.

Second, while the CIA concentrates on the personnel/equipment ratio, it ignores the personnel/operations and maintenance (O&M) ratio.[23] As shown in Table 3, the United States spends one-third more than the Soviet Union on O&M in dollars and, of course, still more in rubles. More revealing, the United States spent $19.1 thousand in O&M per man in 1980 in comparison with Soviet expenditures of $6.7 thousand, or 2.85 times more. The ratio would be still higher if O&M were measured in rubles.[24] Obviously, the

22. CIA, *Soviet and U.S. Defense Activities, 1971–80: A Dollar Cost Comparison* (Washington D.C.: USGPO, January 1981), p. 3. Published annually.

23. Includes all costs associated with the operation and maintenance of weapons systems and facilities, excluding personnel costs.

24. These figures are consistent with the conventional wisdom regarding the economic efficiency of the Soviet economy, to which I subscribe. It is not difficult to believe that the ratio of men to weapons and other such equipment (planes, tanks, jeeps) is similar in the two nations, since such proportions are more or less technologically determined. But the percentages of active

Table 3. U.S. and Soviet Military Expenditures, 1980

	($ billions)		
	U.S.	USSR	USSR/U.S.
Operations			
Military pay & housing	30.4	60.0	1.97*
Operations & maintenance	38.1	29.0	0.76
Total	**68.5**	**89.0**	**1.30**
Investment			
Procurement of equipment and weapons	31.5	52.7	1.67
Military construction	2.6	7.0**	2.69
Total	**34.1**	**59.7**	**1.75**
RDT&E	**12.8**	**25.6**	**2.0**
TOTAL	**115.4**	**174.3**	**1.51**

Sources: U.S. figures from DoD, Annual Report; Soviet figures taken from or based upon percentages of U.S. figures presented in CIA, *Soviet and U.S. Defense Activities, 1971–80: A Dollar Cost Comparison,* January 1981.

* Although the number of Soviet military personnel is more than double that of the United States, we assume that the Soviet soldier is paid slightly less than his American counterpart (Permanent Select Committee, p. 77), and that the Soviet soldier is less adequately housed.

** Based on statement in CIA (1980, p. 11) that construction amounted to 5 percent of Soviet military expenditures over the past decade.

conditions for strong index number effects exist here. And, it should be noted, O&M is an expenditure for both nations that averages to almost the same order of magnitude as weapons procurement; hence its weight in the overall index is similar.

military personnel whose activities are tied in rigid proportions to equipment is probably no more than 25–35 percent. For the rest, the Soviet armed forces undoubtedly represent just an extension of the civilian economy which, as is well known, has much less capital per worker, a lower level of technology, lower labor productivity, and less efficient management than the U.S. civilian economy. Some examples: Donald Kendall, President of Pepsicola, tells of selling the Russians an automated bottling plant requiring 5–6 workers, essentially button-pushers. When he returned some years later and visited the operating plant, he found it "swarming with workers" (personal conversation). Another example: The USSR had 6 chemical plants designed by foreign technicians. These plants were designed to employ 91 auxiliary workers. The Soviets revised the plans and the number was expanded to 430. When finally in operation, the plants employed 732 auxiliary workers or 8 times the number originally projected. M. Feshbach and S. Rapawy, "Labor Constraints in the Five-Year Plan," U.S., Congress, Joint Economic Committee, *Soviet Economic Prospects for the Seventies* (Washington D.C.: USGPO, 1973), p. 488. It is hard for me to believe, in light of these kinds of examples, of labor productivity data, and of anecdotal information, that in the wide range of activities in which military personnel engage that are not directly military (such as feeding men, providing medical treatment, moving supplies, repairing equipment, building roads and other construction, engaging in RDT&E activities), the amount and quality of equipment that these non-combat personnel have to work with and the efficiency with which they work is not far below that in the United States.

It is also worth noting that the U.S. O&M/military hardware ratio is 2.3 times that of the USSR, setting the stage for further index number effects. These would be of less significance than in the personnel/hardware case, however, because the ratios of O&M prices to equipment prices between the two nations would be less different.[25]

Thus, it seems clear that the conditions do exist for expecting reasonably large index number effects in USSR–U.S. military spending comparisons. But one further piece of evidence should be brought to bear on the issue. A study published in 1959 compared U.S. and Soviet GNPs for the year 1955.[26] At that time, conditions unquestionably existed for very large index number effects in the military spending comparison. On the one hand, the Soviets had a military force approximately twice the size of the United States': 5.5–5.8 million men[27] in comparison with the U.S.'s 2.9 million men. On the other hand, American procurements of equipment (and munitions) can be estimated to have been almost twice those of the Soviet Union.[28] More than now, relative prices must have been in inverse relationship to the quantity relationships, with American wages relatively much higher than the Soviets', and their costs of equipment relatively much higher than those of the United States. Despite these favorable conditions for index number effects, the dollar–ruble spread in military spending was relatively small in comparison with those for the rest of the economy, as shown in Table 4.

Clearly, it is necessary to look elsewhere to explain the low index number spread in defense, both in 1955 and more recently.[29] That explanation—the

25. One cannot pass over this paragraph without at least noting another implication of the data. There is constant concern in the United States about our state of readiness for military action. However, if we are spending about 2½ times as much as the Soviets are per person and per piece of equipment, we must certainly be better prepared than they are, even allowing for the greater complexity of our equipment.

26. Morris Bornstein, "A Comparison of Soviet and United States National Product," in Franklyn D. Holzman, *Readings on the Soviet Economy* (Chicago: Rand McNally, 1962).

27. Abram Bergson, *The Real National Income of Soviet Russia Since 1928* (Cambridge: Harvard University Press, 1961), p. 364, and J. G. Godaire, "The Claim of the Soviet Military Establishment," in U.S., Congress, Joint Economic Committee, *Dimensions of Soviet Economic Power* (Washington D.C.: USGPO 1962), p. 43.

28. Crudely estimated from data in Bergson, *The Real National Income,* p. 364 and Bornstein, "A Comparison of Soviet and United States National Product," p. 385.

29. The index number spread in 1974 was only 1.09 (Table 5). Since in 1974, the USSR presumably was quite a bit behind the United States in military equipment procurements, according to CIA arguments, one would have expected a larger index number spread. This also needs explaining.

Table 4. USSR/U.S. Expenditure Ratios, 1955

	rubles	dollars	dollar /ruble spread
GNP	.268	.534	1.99
Consumption	.208	.390	1.88
Investment	.488	.683	1.42
Defense	.753	.943	1.25

high level of aggregation at which comparative defense expenditures must have been calculated in rubles—is discussed in the following section.[30]

Insufficient Ruble Prices and the Ruble Comparison[31]

The Deputy Director of Intelligence of the CIA admitted in 1975 that the high level of aggregation at which the military expenditure comparison is made in rubles is responsible for reducing the index number spread.[32] My contention in *International Security* that this was the case has nevertheless been greeted with considerable skepticism by some academics and by CIA economists.[33] The significance of the effects of aggregation is poorly understood and, to my knowledge, has been little investigated in the literature of comparative economics.[34] Most of the confusion results from the fact that if an

30. Bornstein reported that he had only 2 or 3 ruble prices (dollar–ruble price ratios) available for the military spending calculation in rubles (personal conversation).

31. I assume here that the CIA ruble prices are "real" ruble prices; but from informal statements dropped here and there, I have gathered that this is not always true. Without going into this matter in detail, I would like to quote two informed outsiders, William Lee, who worked for the CIA for many years, and Steven Rosefielde, who in recent years, has had access to classified CIA materials. Rosefielde says: "The Agency possesses only a limited number of authentic ruble prices for weapons found in the Soviet arsenal. Most of its so-called ruble prices are actually derived from dollar parametric cost-estimating relationships of American weapons converted into rubles with sundry ruble–dollar ratios" (Permanent Select Committee, *CIA Estimates*, p. 14). Now Mr. Lee: ". . . the CIA's so-called 'constant 1970 rubles' are constructed quite differently than Soviet constant 1970 rubles for the same goods. . . . In effect the CIA's constant rubles are simply constructs generated by the CIA's direct costing model. The Soviets do not spend CIA rubles any more than they spend dollars. Nor do they keep their accounts or make their decisions in CIA rubles. The Soviets use their own rubles for such purposes" (Committee on Armed Services, *Soviet Defense Expenditures*, p. 112).

32. U.S., Congress, Joint Economic Committee, *Allocation of Resources in the Soviet Union and China* (Washington D.C.: USGPO, 1975), p. 25.

33. U.S., Congress, Joint Economic Committee, *Allocation of Resources in the Soviet Union and China* (Washington D.C.: USGPO, 1980), p. 150; Permanent Select Committee, *CIA Estimates*, p. 75.

34. See, however, F. B. Horner, "Effect of Grouping of Data on the Divergence between Laspeyres and Paasche Forms of Quantum Indexes," *Review of Income and Wealth*, Vol. 17, No. 3 (September 1971) and Gilbert DeBartolo, "The Effects of Aggregation on the Difference between Laspeyres and Paasche Indices," an unpublished paper.

index is constructed correctly, then it should not matter whether it is constructed on the basis of individual commodities or on the basis of groups of commodities. That is to say, if we have 100 commodities produced by the United States and the Soviet Union and we have 100 individual dollar prices, then it will not matter if the index is built up by weighting the quantities of the individual commodities in each country directly by their respective prices (as in our orange-croissant example)—or whether we first use the dollar prices to combine the 100 commodities into 10 groups of 10 commodities each and then combine the 10 groups by 10 properly weighted average dollar prices to get the final dollar values.

Suppose, on the other hand, that when we turn to make the comparison in rubles, we have ruble prices available for ten individual commodities, but none for the remaining 90 commodities. In this event, each of the 10 ruble prices serve as a proxy for the group of commodities most closely related to it. The problem is how to subaggregate the 10 commodities in each group without *individual* ruble prices. In this particular situation, there would seem to be only one practical course of action, namely, to combine the commodities in each group in each country by using dollar prices. Then, each resulting group value in dollars for each country is converted into rubles, using the single dollar–ruble price ratio of the commodity(ies) for which a ruble (as well as a dollar) price is available.[35] The groups, now valued in rubles, are summed to yield a total military expenditure figure in rubles for each country. This, in fact, is an idealized sketch of the CIA procedure when detailed ruble prices are unavailable, as the following CIA source makes clear:

In our latest ruble estimate, about half of total Soviet defense spending was estimated directly in rubles. For the remaining components of defense spending, we first estimated what it would cost to carry out the Soviet activities in

35. To make this absolutely clear, consider the following example: suppose the Soviets produce ten different kinds of military vehicles. Suppose it is possible to assign dollar prices to each type, but that a ruble price is available for only one of these vehicles, say, a jeep. Assume the jeep has a U.S. price of $4000 and a Soviet price of 2000 rubles, for a dollar–ruble ratio of 2. If the total value of Soviet vehicles in dollars adds up to $10 million, this value would be converted to 5 million rubles, using the jeep dollar–ruble ratio. The same procedure would be followed in valuing U.S. vehicles in rubles. Yet, the jeep dollar–ruble ratio may be quite different from those of the other nine vehicles (typical differences in dollar–ruble ratios within groups of machinery and equipment are presented below). Nevertheless, this procedure assumes that they are all the same, thereby eliminating whatever index number effects might result from relative differences in ruble and dollar prices among the nine vehicles for which ruble prices are unavailable.

the United States and then converted these dollar costs to ruble terms. The conversion factors are based on samples of prices of Soviet military equipment and activities. The reliability of our conversion factors depends, of course, on the accuracy of the price information and on the extent to which the sample reflects the overall price relationships for various categories of defense products.[36]

What are the implications of this procedure for the index number spread? The major implication is that each group, valued in dollars rather than in rubles will, for the usual index number reasons, result in a higher value of Soviet spending relative to U.S. spending.[37] The final comparison, always dubbed a "ruble comparison," is in fact partly made in dollars and partly in rubles. Comparisons like those made by the CIA before, say, 1977,[38] when approximately 10 ruble prices were available, are actually almost entirely dollar rather than ruble comparisons when one considers that there are admittedly at least ten thousand individual items included in each nation's military expenditures,[39] almost all of which were weighted in dollar prices. This must still be true despite the increased numbers of ruble prices the CIA claims to have. In the important hardware procurement sector, James Steiner of the CIA claims some 135 prices,[40] which is not a large number in light of the fact that there must be several thousand items in this major expenditure

36. Response of Donald Burton, CIA, to questioning in Hearings before the Senate Committee on Armed Services (*Soviet Defense Expenditures*, p. 127). The half of Soviet defense spending estimated directly in rubles is military personnel and RDT&E. The CIA report provides a similar statement: "By a variety of methods . . . [the physical] data base is converted into two value estimates, one in rubles, the other in dollars. For some components, such as military personnel, the data are costed directly, using ruble prices and costs and dollar prices and costs. For other components, conversions are made from one value base to the other by applying dollar-to-ruble and, to a more limited degree, ruble-to-dollar conversion factors" (*Estimated Soviet Defense Spending*, p. 13).

37. To illustrate this point, let us return to the U.S.–French comparison in Table 1. In Table 1, we had as many French prices as commodities (2) and were able to convert each nation's breakfast into francs directly, revealing that the United States was spending more than France, valued in franc prices. Suppose that individual franc prices were not available and that valuation into francs had to be implemented by first valuing each nation's breakfast in dollars and then converting into francs by some "reasonable" average dollar–franc ratio. Suppose a $1–4 franc ratio were used. Following this procedure, the costs in francs would be U.S.–4F, France–5F, or just the reverse of the result from using real franc prices. No matter what dollar–franc ratio is chosen, the dollar-valued ratio of French/U.S. cost will be translated, unchanged, into francs, thereby resulting in a maximum rather than a minimum French–U.S. cost ratio.

38. U.S., Congress, Joint Economic Committee, *Allocation of Resources in the Soviet Union and China* (Washington D.C., 1975), p. 24, and Joint Economic Committee, Congress of the United States, *Allocation of Resources in the Soviet Union and China* (Washington D.C., 1977), p. 25.

39. Permanent Select Committee, *CIA Estimates*, pp. 88, 91.

40. Public talks, April 15 and 24, 1981. Cited in article by Henry Bradsher, in *The Washington Star*, April 19, 1981.

Table 5. Ruble and Dollar Comparisons of Soviet and U.S. Defense Expenditures: USSR/U.S.

CIA estimates* in:	1974	1976	1978	1980
Dollar prices	1.20	1.40	1.45	1.50
Ruble prices	1.10	1.25	1.25	1.30
Index number spread	9%	12%	16%	15%
Estimated USSR/U.S. ruble price comparison assuming index number spread to be:**				
3 times larger	.94	1.03	.98	1.03
5 times larger	.83	.88	.81	.86
8 times larger	.70	.71	.64	.68

Note: to the extent that the larger CIA index number spreads in the later years may be attributable to the availability of a greater number of ruble prices, smaller hypothetical spreads are more appropriately assumed for these years than for the two earlier years.

* From CIA, *Soviet and US Defense Activities*, various issues; JEC, various years.

** Let me illustrate these calculations. In 1974, the CIA estimated USSR/U.S. ME=1.20 in dollars and 1.10 in rubles. Since 1.20/1.10=1.09, the spread is 9 percent. Suppose the true spread, based on full availability of ruble prices is three times as large, or 27 percent. Since we assume the dollar ratio of 1.20 is accurate, we calculate the ruble ratio (r) as 1.20/r=1.27, or .94.

category. Given the very high dollar content of the CIA's ruble indexes, it seems almost certain that, before 1977, and perhaps even now, these indexes reflected a higher ratio of USSR/U.S. defense expenditures than would a geometric mean of the dollar and a "true" ruble index.

Some ratios of index number spreads as a function of the level of aggregation have been calculated for manufactured products in the United States and the United Kingdom.[41] The calculations show that, to the extent that subaggregation was done in the wrong set of prices (analogous to the CIA's use of dollar prices in subaggregating for its ruble estimate), the true index number spread ranged from double to one hundred times larger than the spread based on these improperly calculated indexes. In Table 5, I estimate, for illustrative purposes, ruble comparisons of USSR–U.S. defense expenditures under different assumptions, as suggested by Horner, regarding the degree to which insufficient ruble prices affect the index number spread. If the assumptions in Table 5 are reasonable, then it is clear that the CIA's ruble

41. Presented in Horner, "Effect of Grouping of Data."

comparisons reflect a substantial overstatement of Soviet defense expenditures.[42]

The CIA seems quite content with its ruble estimates at present. Until 1977, ruble estimates were not presented in the annual defense expenditure report but only in response to congressional questioning and always with a derogation such as "casual," "rough," and "unofficial." Now they are presented officially in the annual report. Optimism regarding the current ruble estimate comes out in CIA testimony before the House Select Committee on Intelligence:

> Professor Holzman mentioned 10 sectors of defense that he thought we had ruble–dollar ratios on. That was the state of our art 5 or 6 years ago, but we don't do that anymore today. We have literally hundreds of calculations, hundreds of different components that we look at when we apply our different weights, and they are then aggregated together.[43]

While "hundreds" is certainly an improvement over ten, and might explain the small increase in index number spread that occurred between 1974 and 1980 (Table 5), it is still a small percentage of the total number of prices required for an unbiased estimate: the current ruble estimates are still, to a considerable extent, dollar estimates. The CIA's confidence in its ruble comparisons, as expressed above, is somewhat belied by the fact that in its most recent annual USSR/U.S. comparison, the ruble estimate gets only two sentences in the text and a footnote.[44] If it were as reliable as suggested, then it should, in good conscience, be given more visibility in the CIA annual report and the dollar–ruble geometric mean should be presented as the most authoritative measure of the comparative arms expenditures of the two nations.

The fact is that the CIA has been downgrading its ruble estimate. In earlier years, the excuse for not presenting it officially was that not enough ruble prices were available and the estimates were, therefore, unreliable. Nevertheless, ruble prices were admitted to be as relevant as dollar prices in comparing defense establishments.[45] Now the justification is offered that the

42. These comparisons, it should be noted, take no account of other factors which tend to overstate Soviet military expenditures in both the dollar and ruble comparisons made by the CIA. See Holzman, "Are the Russians Really Outspending the U.S.?"
43. Permanent Select Committee, *CIA Estimates*, p. 76.
44. CIA, *Soviet and U.S. Defense Activities, 1981*, p. 11.
45. U.S., Congress, Joint Economic Committee, *Allocation of Resources in the Soviet Union and China* (Washington D.C.: USGPO, 1975), pp. 25–26.

CIA "uses the dollar as [the] measure because it is familiar to U.S. policymakers and because U.S. defense planning is generally done in dollar terms."[46] But this is a specious argument. The major use made of the CIA's unclassified comparisons is to give to American policymakers and to the public ratios of USSR/U.S. spending both in the aggregate and in individual sectors. So, we are told, the Soviet Union outspent the United States in dollars by 1.50 times in 1980. But the CIA could just as well tell us that the Soviet Union outspent the United States by 1.396 times, the geometric mean of the 1.50 dollar and 1.30 ruble ratios.[47] If an absolute value in dollars of Soviet spending is required for some purposes, it would be simple enough to multiply the U.S. defense figure in dollars by 1.396. True, it might be argued that it is not appropriate to put the geometric mean of dollar and ruble measures into dollars. However, it is done frequently in other kinds of calculations.[48] Further, given the ultimate purpose of the calculations, namely, to inform U.S. citizens and policymakers of the relative magnitudes of the two nations' defense expenditures, then a more accurate portrayal is provided by the geometric mean converted into dollars than by how much it would cost the United States in dollars to reproduce the Soviet military establishment. If detailed real dollar breakdowns are required by some U.S. military planners, the CIA can certainly provide these in some other format.

Soviet Military Expenditures as a Percentage of GNP

While most public attention is focussed on the CIA's comparisons of U.S. and Soviet military expenditures, the CIA also makes estimates of the percentage of Soviet GNP that is devoted to military expenditures (ME/GNP). Military expenditures and GNP are always in "constant 1970 ruble prices" so that the changes over time will reflect "real" trends and not be affected by price changes, and also because few, if any, more recent ruble prices are available.

46. CIA, *Soviet and U.S. Defense Activities*, p. 11. This argument was also made by CIA spokesmen James Steiner (cited above) and Derk Swain in a public talk in October 1980.
47. Of course, as argued above, the "true" ruble ratio and geometric mean for 1980 would be much lower.
48. In fact, a procedure similar to this is used in the largest and most prestigious international output comparison ever attempted. Cf. Irving Kravis, Z. Kenessey, A. Heston, and R. Summers, *A System of International Comparisons of Gross Product and Purchasing Power* (Baltimore, MD: Johns Hopkins University Press, 1975).

The most relevant ruble prices for measuring ME/GNP for a recent year, say, 1980, would be 1980 ruble prices. Using 1970 rather than 1980 ruble prices exaggerates the 1980 ME/GNP because it has differential effects on the numerator and denominator respectively. Valuing 1980 Soviet ME in 1970 ruble prices exaggerates the value of 1980 ME. This is another example of the index number problem, but applied to intertemporal comparisons within a nation. Just as U.S.(Soviet) prices provide upper limits of Soviet(U.S.) output, so 1970(1980) Soviet prices provide upper limits of 1980(1970) Soviet outputs. In this particular case, all the newer Soviet military equipment that was just being introduced or, perhaps, hadn't been produced yet, in 1970 and therefore had high 1970 prices, constitutes a relatively large part of Soviet procurements in 1980 (in which year their prices would be much lower due to economies of scale and experience).

What is true of Soviet military expenditures is also true of Soviet GNP—1980 GNP will also be exaggerated by being valued in 1970 prices. If ME and GNP were equally affected by 1970 prices, the ratio of ME/GNP would be the same regardless of whether 1970 or 1980 prices were used. In fact, however, this does not appear to have been the case. According to Western analysts, Soviet military equipment was technologically upgraded with remarkable rapidity in the 1970s, whereas the civilian economy plodded along at a tortoise pace. This means, of course, that the exaggeration of ME in 1970 prices must be much greater than that of GNP and the ratio of ME/GNP therefore substantially overstated. It is impossible to say how great an impact the use of 1970 prices may have had on recent ME/GNP ratios. But in periods of rapid economic change—as was the case in the Soviet military sector during the 1970s—such index number effects have been very large indeed. So, for example, the amount by which Soviet 1937 GNP exceeded Soviet 1928 GNP is more than twice as large in 1928 prices as it is in 1937 prices.[49] If Western analysts are correct about Soviet military progress, it would not be surprising if 1970 ruble prices (relative to 1980 prices) exaggerated ME/GNP by say, one-third or one-half this amount.

This line of reasoning must be modified, however, for the fact noted earlier that due to insufficient 1970 ruble prices, approximately half of Soviet ME is first subaggregated in 1970 dollar prices. This reduces the exaggeration implicit in a 1970 ruble measure of 1980 ME, hence of ME/GNP. This is because

49. Bergson, *The Real National Income*, p. 217.

1970 dollar prices, representing scarcity relationships of a more advanced economy, probably reflect more closely Soviet 1980 scarcity relationships in the military sectors in question than do 1970 ruble prices. The maximum effect would result from a situation in which 1970 dollar price patterns were identical to those of 1980. The further that 1970 dollar price patterns deviate from 1980 Soviet scarcity relationships, the less effect there will be in reducing the exaggeration in the estimate of 1980 ME. Economic theory dictates that the minimum costs (value) of a package of goods (weapons) purchased in a particular year is that which is valued in the relative prices of that same year, rather than in prices of earlier years (pre-1980) or in prices which represent future scarcity relationships (post-1980) as 1970 U.S. dollar prices might. This theory, which serves as the basis of our earlier index number arguments, does not apply as well under arms race conditions as it does in competitive markets, as our earlier CIA quote suggests. Nevertheless, it does provide some guidance for assessing the impact on ME/GNP of subaggregation in dollars.

To summarize, the CIA's current estimates of Soviet ME/GNP are subject to significant overstatement due to the use of 1970 rather than current ruble prices. This overstatement is reduced by the fact that part of ME is subaggregated in 1970 dollar prices. The extent by which the overstatement is reduced depends on how well dollar prices proxy for 1980 Soviet prices. Further, since half of Soviet ME are calculated directly in 1970 rubles (manpower and R & D), my guess would be that, aside from other complications (below), the CIA's estimate is still considerably too high.

The complications referred to related to the fact that in those sectors in which subaggregation in dollars occurs, there are approximately 135 useable ruble prices, hence only 135 dollar-ruble ratios to convert the dollar values into rubles. How well these limited number of conversion ratios represent the thousands of underlying ruble prices of commodities on which no price information is available is an important matter. As Mr. Burton of the CIA admits, "[t]he reliability of our conversion factors depends, of course, on the accuracy of the price information and on the extent to which the sample reflects the overall price relationships for various categories of defense products."

How reliable can a sample be in reflecting the price relationships of a larger category of defense products? Not very reliable, I would say, in light of a recent (1980) two volume CIA study entitled *USSR and the United States: Price Ratios for Machinery, 1967 Rubles–1972 Dollars*. This study showed that there

were substantial differences in ruble–dollar ratios not only *between* groups of different types of machinery but also *within* each group.[50] In the case of trucks, for example, a 12-ton platform had a ruble–dollar ratio of .33 (Soviet cost in rubles was one-third of the U.S. cost in dollars), whereas the ratio for two-ton platforms was .56. A 52-horsepower jeep had a ratio of .39 in contrast with 95-horsepower passenger cars with a ratio of .97. In agricultural machinery, the ratios ranged from .13 to .99; in pumps and compressors, from .11 to 1.73; and so forth.[51]

In light of the above, it would appear that selecting appropriate dollar–ruble conversion ratios from a small sample must be essentially a guessing game. If one can assume that in this guessing game, the errors are randomly distributed—i.e., that the "too high" ratios are just offset by the "too low" ratios—then it would be reasonable to infer that the CIA's overall ruble valuation of Soviet ME/GNP would be too high because of the balance of index number effects already discussed. Assuming random errors and in light of the magnitudes of the index number effects, it would not surprise me if, currently, a properly measured Soviet ME/GNP were a percentage point or two below the CIA's current figure of 12–14 percent. This is, of course, just a guess. Further, since we don't know the particular biases in the dollar–ruble ratios available to the CIA, we are really in the dark as to the reliability of the whole estimate.

The Growth of Soviet Military Expenditures

The CIA regularly publishes figures on the growth of Soviet ME. Over the decade of the 1970s, average annual rate of growth in current dollars has been estimated at 3 percent and over 1967–77 in constant 1970 rubles at from 4–5 percent.[52] The dollar figure is lower than the ruble because: 1) the rapidly growing advanced weaponry of the Soviets is valued at low U.S.

50. According to the study, many of the differences in ruble–dollar ratios between commodities in a particular group reflect differential quantities produced and consumed in one or the other nation. Large quantities produced usually lead to economies of scale and lower prices.
51. CIA, *USSR and the United States: Price Ratios for Machinery, 1967 Rubles–1972 Dollars* (Washington D.C., 1980).
52. CIA, *Estimated Soviet Defense Spending*, p. 1. This latter figure (4–5 percent) is something of a puzzle. The CIA states that Soviet ME grew "from 35–40 billion rubles in 1967 to 53–58 billion rubles in 1977." Actually, 35 to 53 represents an annual rate of 4.2 percent, 40 to 58 billion represents a growth of 3.8 percent, and using the midpoints, 37.5 to 55.5 represents a growth of 4 percent annually! When we consider the enormous effort that goes into all of these calculations, it is difficult to understand how such an error could be made.

current prices in dollars but in very high Soviet ruble prices based on Soviet production technology of 1970, and 2) the relatively constant-sized Soviet army gets a much higher weight in dollars than in rubles.

Ideally, growth of Soviet military expenditures over the 1970s should be measured in ruble prices, as represented by, say, a geometric mean of 1970 (which shows a high rate of growth) and 1980 (a lower rate of growth) prices. The CIA use of Soviet constant 1970 ruble estimates is flawed with regard to this practical ideal in three respects.

First, as noted earlier, the 1970 ruble estimates are based on subaggregation in dollars. Subaggregation in 1970 dollars reduces the rate of growth of these subaggregates because it puts a relatively low price on the fast-growing modern Soviet weaponry and a high price on the relatively constant-sized army. Evidence of this type of effect is contained in the comparison between current dollar and 1970 ruble growth rates cited just above. A 1970 ruble series based exclusively on Soviet ruble prices would undoubtedly show a much more rapid growth in Soviet ME.

Second, no attempt has been made to value Soviet ME over time in more recent ruble prices, say 1978 or later. In these later years, ruble prices of newly developed weapons should be much lower than in 1970. Lower price weights on these fast-growing military items would reduce the growth rate of Soviet ME much below that measured in 1970 rubles and would provide, in effect, a reasonable lower growth rate limit. Where a geometric mean of indexes based on 1970 and (say) 1980 rubles would fall relative to the CIA's "subaggregation in dollars" constant 1970 rubles index is difficult to guess. It depends partly on whether dollar weights (which presumably have an effect more similar to 1980 rubles) or 1970 ruble weights predominate in the CIA index, since in the "ideal" index, 1970 and 1980 rubles have an equal weight. Before 1977, when dollars may have predominated, the CIA index may have understated the growth of ME; since 1978, with many more 1970 ruble prices, the reverse may be true.

Third, as noted above, the dollar–ruble conversion ratios used by the CIA to convert dollar subaggregates into 1970 rubles may or may not ". . . reflect the overall price relationships for various categories of defense products. . . ."[53] This adds another large element of uncertainty into the CIA's constant 1970 ruble calculation of the growth of Soviet ME.

53. Statement by Donald Burton of the CIA cited above.

In summary, perhaps the only thing that we can say for sure about CIA measures of the growth of Soviet ME is that they are understated by the CIA's dollar-weighted measure.[54] Growth of Soviet ME measured in "true" 1970 rubles would show a much greater rate of growth than either the CIA's dollar or so-called constant 1970 ruble measure; and measured in current (1980)[55] rubles, growth of Soviet ME would also exceed the dollar measure, but by a lesser amount. The CIA's constant 1970 ruble index probably currently represents a small overstatement relative to the ideal.

Conclusion

It is generally accepted that international comparisons of output differ depending on which nation's prices are used as weights. For this reason, it is considered desirable to present such comparisons either in the form of a range based on the two sets of prices or in the form of some kind of average of the two estimates.

The CIA bases its comparisons of U.S. and Soviet military expenditures on dollar price weights, which tend to provide an upper limit for Soviet relative to U.S. military expenditures.[56] Ruble comparisons have been downgraded by the Agency. In the early and mid-1970s, the claim was that there were not enough data to make a good ruble estimate; today, the ruble estimate is viewed as more robust, but it is argued (speciously) that dollars are the measure in which American policymakers think. The CIA has also never failed to point out that the ruble comparison differed little from the dollar comparison—in either case, the Soviet Union outspent the United States by close to the same percentage. More recently, CIA spokesmen have explained the similarity of the dollar and ruble comparisons by the contention

54. Abstracting from the possible distortions introduced by non-index number problems. Holzman, "Are the Russians Really Outspending the U.S.?"

55. It may be that 1980 ruble prices which are representative of changes in economic conditions and production techniques since 1970 do not exist. The last Soviet price reform was in 1967. 1970 ruble prices are, basically, 1967 prices. The same is true of most 1980 ruble prices. So, in effect, we may be speaking here, as earlier, of shadow rather than real 1980 ruble prices.

56. The CIA recently revealed, for the first time, a U.S./China (PRC) military spending comparison in current dollars. This estimate provides a *reductio ad absurdum* of using a dollar measure for nations whose wages and prices are relatively so different from ours and whose military establishments, reflecting these prices, are also very different. As Senator Proxmire put it to a CIA spokesman: "Doesn't your calculation that shows that Chinese defense activity is about equal to the United States' illustrate an obvious fallacy in the approach?" Joint Economic Committee, Congress of the United States, *Allocation of Resources in the Soviet Union and China* (Washington D.C.: USGPO, 1980), p. 151.

that the proportions of personnel to weapons as well as the proportions among different kinds of weapons were very similar—a situation in which index number effects are reduced.

In 1975, the Deputy Director for Intelligence of the CIA admitted that the scarcity of ruble prices on which to base ruble estimates reduces the index number effects—which means that the ruble estimate does not differ as much from its corresponding dollar estimate as it should. In effect, Soviet military expenditures are relatively overstated in rubles. This is because subaggregation must be done in dollars, so that the resulting so-called ruble estimate is a hybrid constructed from a combination of dollar and ruble price weights. Through 1977, the ruble estimate must have been primarily a dollar estimate because so few ruble prices were available. Further, in the earlier period, the recent argument that the military establishments had similar proportions each year would have had much less validity—if there is anything to the "Soviet build-up over the seventies" argument—and it would seem that there is. I would conclude, therefore, that the CIA's ruble estimates strongly exaggerate the size of Soviet military expenditures relative to those of the United States, especially through 1977. Based on the hypothetical estimates regarding aggregation errors presented in Table 5, I would contend that the United States outspent the Soviet Union through 1977, as measured by a geometric mean of dollar and "true" ruble estimates. This is not only the period when the CIA had very few ruble prices,[57] but also when a CIA spokesman admits that CIA estimates of the quality of Soviet military equipment often exaggerated its value[58] and when the technology gap was much larger and not reflected in properly high ruble valuations of U.S. military equipment.

Regarding the period since 1977, I would contend: 1) that the military establishments are not so similar as to preclude index number effects, and 2) that while the CIA clearly has more ruble prices than in earlier years, it still lacks enough such prices to construct a real ruble index, with the result that its index still significantly overstates Soviet military expenditures. If we adjusted for aggregation bias for this period, I believe that a dollar–ruble geometric mean would show the Soviet Union overtaking the United States

57. U.S., Congress, Joint Economic Committee, *Allocation of Resources in the Soviet Union and China* (Washington D.C.: USGPO, 1975), p. 24; U.S., Congress, Joint Economic Committee, *Allocation of Resources in the Soviet Union and China* (Washington D.C.: USGPO, 1977), p. 25.

58. Permanent Select Committee, *CIA Estimates*, pp. 75–76.

and, by 1980, possibly exceeding American expenditures by a small percentage. Since other above-mentioned errors of estimation would be reduced by 1980, I believe that Soviet military expenditures still exceed those of the United States even after further adjustments.

Because Soviet military expenditures are measured in 1970 rather than current rubles, the CIA's measure of Soviet ME/GNP is too high despite the fact that a good part of these ME are subaggregated in 1970 dollars. Taking account of these factors, I would not be surprised if, properly calculated, Soviet ME/GNP were one or two percent below the CIA's twelve to fourteen percent. It is important to stress that the calculation of Soviet military expenditures in rubles is further confounded by the problem of estimating representative dollar–ruble ratios with which to convert subaggregates from dollars to rubles. From the outside (of the CIA), this appears to be a problem which could lead to huge errors of estimate, in either direction.

Finally, the rate of growth of Soviet ME is also affected by index number considerations. The CIA's dollar measure must be lower than that which would result from our "ideal" index, assuming the ideal could be estimated. The CIA's constant 1970 ruble measure is probably currently higher than the ideal, the extent depending on the relative importance of dollar and 1970 ruble prices, respectively, among its weights.

The CIA devotes a huge amount of money, manpower, and external intelligence resources to its comparisons of Soviet–American defense expenditures, and to its measures of Soviet ME/GNP and growth of ME. The Agency should provide U.S. decision-makers with as accurate and unbiased estimates as are possible on such important subjects. It is therefore very unfortunate that the CIA's estimates are often unnecessarily biased and, where biases are unavoidable, their effects on the results are not more clearly stated and more urgently stressed.[59]

59. As this essay goes to press, I received unclassified, but unpublished, information on CIA ruble costing procedures. This information indicates, contrary to CIA statements quoted above, that some military equipment for which authentic ruble prices are unavailable is not subaggregated in dollars. Rather, by a variety of techniques, CIA analysts have made a variety of estimates which they believe approximate "true" ruble prices. To the extent that they have been successful, the upward bias in ruble estimates of Soviet military spending would be reduced. At this point, I have no idea how successfully the CIA techniques capture the real factors causing ruble–dollar cost differentials, nor do I know the extent to which these shadow ruble prices replace dollar prices in the aggregation process. Since the number of shadow prices that can be estimated depends, in part, on the number of actual prices available, these methods could not have had a discernible effect before, say, 1978.

NOTES

☆U.S. GOVERNMENT PRINTING OFFICE: 1982-360-974:2063